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The Effects of Exercise on Social Rejection, Anger, and Aggression

Research Thesis

Presented in partial fulfillment of the requirements for graduation
With research distinction in Psychology in the undergraduate colleges of
The Ohio State University

By

Kelsey Moran

The Ohio State University
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Project Advisor: Dr. Baldwin Way, Department of Psychology

Abstract

Being excluded by others is a painful experience. Because exercise can improve mood and trigger endogenous pain suppressing chemicals, we asked if exercise could reduce reactivity to social exclusion. In study 1, two hundred fifty-eight (121 female) people self-reported on their exercise frequency and were rejected from an online ball-tossing game, Cyberball. Hurt feelings, anger, and aggressive intentions were measured post-exclusion. Results demonstrated higher self-reported aerobic exercise frequency was associated with less hurt feelings, and less anger, but there was no relationship with aggressive intentions. These findings suggest that exercise reduces responses to social stressors like rejection. To determine if these effects of exercise are causal, study 2 brought forty-two (16 female) participants into the lab in groups of 3 or 4. Half of the participants completed 50 minutes of aerobic exercise (heart rate 140-160 bpm), while the other half remained inactive. After this, all participants engaged in a get to know you group discussion for 15 minutes. Subsequently they were either excluded or included from a follow-up task. Results demonstrated that exercise reduced feelings of sadness and anger, while being rejected decreased feelings of inclusion and positive affect and increased sadness with marginal increases in anger. Exercise also resulted in a significant increase in anger after the social interaction. Feelings of inclusion, sadness and positive affect were differentially responsive between the exercise and no-exercise conditions. Those who had exercised were less emotionally responsive to inclusion or exclusion. Taken together, these studies suggest that exercise reduces reactivity to social rejection and may also reduce responses to social inclusion. Possible explanations for the effects of exercise on mood as well as increased anger are discussed.

"When we feel like we belong we feel connected and we feel safe. As humans we crave the feeling and we seek it out." – Simon Sinek.

All humans have basic needs that are essential for survival. Maslow (1968) constructed his motivational hierarchy with a foundation of food, hunger, and safety, (Baumeister & Leary, 1995). Secondary only to basic needs are belongingness needs, taking precedence over esteem and self-actualization (Baumeister & Leary, 1995). This desire to be attached to others, fuels many of the behaviors humans exhibit throughout daily life. The ability to form social attachments typically gives rise to positive emotions (Baumeister & Leary, 1995). However, the lack of belongingness and social attachments can create psychological and physical health problems. Many emotional problems that people seek help for, such as anxiety and depression, are the result of people's inability to meet their belongingness needs (Baumeister & Leary, 1995). One type of deficiency in belongingness needs is social rejection. This experience has been described as quite painful, but why might separation from others be experienced as painful (MacDonald & Leary, 2005)?

Social Pain

Social rejection is one form of social pain. Social pain refers to a "specific emotional reaction to the perception that one is being excluded from desired relationships or being devalued by desired relationship partners or groups (MacDonald & Leary, 2005, p. 203). Feeling less valued or excluded from relationships is believed to signal an increased likelihood of ultimate exclusion (MacDonald & Leary, 2005). The emotions that accompany those experiences are known as hurt feelings (MacDonald & Leary, 2005). All of these emotions fall into the category of social pain. Social pain stems from the possibility of being separated from important social

groups, which could result in survival challenges (MacDonald & Leary, 2005). These supposed challenges are what psychologically cause social pain to hurt, because inclusion is believed to have been evolutionarily imperative for survival (MacDonald & Leary, 2005).

Social Pain and Physical Pain Overlap – Psychological

Social pain overlaps emotionally with physical pain, but the relationship extends further, coinciding in language and disorders. When a person describes physical pain, words such as "stabbing", "ripping", or "hurting" may commonly be used. Such words are also used quite often to describe feelings of social pain. Phrases such as "broken hearted", "ripped my heart out", "deeply hurt" or "having a crush on someone" are commonplace in daily life (MacDonald & Leary, 2005). The two types of pain cannot only be interchanged metaphorically, but clinically as well. Not only do higher levels of depression relate to a higher likelihood of experiencing physical pain, but also responses to depression and chronic pain are so similar that medical professionals often confuse them (MacDonald & Leary, 2005). Therefore it is clear that social pain and physical pain overlap psychologically, however does the relationship extend to a biological level?

Social Pain and Physical Pain Overlap - Neurological

It was first proposed by Panksepp (1998) that a primitive regulation system consisting of place attachment and physical pain was the basis for the social attachment system. This system is suggested to be involved with the emotional distress felt during social absence or when belongingness is not achieved (Herman & Panksepp, 1978). This biological link between systems has been investigated through painkillers. The painkiller morphine has been shown in animals to not only reduce the distress of physical pain, but also social separation (Panksepp, 1998). In humans as well, the neurochemical system involved in physical pain has also been

shown to be involved in social pain (Way, Taylor, & Eisenberger, 2009). If physical pain and social pain share the same neurochemical systems, can other physical painkillers reduce the feelings of social pain?

A recent study by DeWall et al., (2010) demonstrated that a physical analgesic, acetaminophen (Tylenol), can reduce social pain. Participants reported a reduced amount of hurt feelings in daily diary reports (DeWall et al., 2010). The neurochemical pathways by which acetaminophen exerts its analgesic effect are not clear, but appear to involve the cannabinoid system because mice without Cannabinoid-1 (CB_1) receptors are not responsive to acetaminophen (Mallet et al., 2008). This raises the question as to whether endogenous cannabinoids are involved in responses to social rejection and hurt feelings. How can cannabinoid levels be raised in humans? One answer is exercise. One study found a significant increase in anandamide after 50 minutes of cardiovascular exercise (Sparling, Giuffrida, Piomelli, Rosskopf, & Dietrich, 2003). This link between exercise and endogenous cannabinoid release, raises the question as to what other effects exercise has and whether or not it can effect social rejection?

Exercise - General

Exercise has been established as beneficial for physical health, and the literature is becoming increasingly consistent regarding the psychological effects of exercising, specifically the mood changes that occur post-exercise. Broad forms of exercise have been investigated including swimming, running, biking, dance, and yoga. These forms of exercise have been shown to result in a range of positive emotions (Berger, 1996; Roth, 1989; Stephens, 1988). Not only has research demonstrated that exercise can result in positive affect, but several studies have also established the positive association between physical activity and mental health. The extent

to which exercise has been found to correlate with positive mental health has lead researchers to specifically investigate exercise as a treatment option.

Exercise – Anxiety and Stress

Exercise is believed to be an effective treatment to diminish anxiety and stress. Exercise has been shown to be more effective than quiet resting for reducing anxiety and tension, and may provide a diffuse anti-anxiety effect from mental stressors (Roth, 1989). Acute reductions in anxiety post exercise have been replicated in many studies and as little as 30 minutes of aerobic exercise has shown to reduce the frequency and intensity of anxiety-related thoughts, and dampened blood pressure reactivity to psychosocial stress (Rajeski, Thompson, Brubaker, & Miller, 1992; Roth, 1989). Exercise is known to reduce and cushion responses to other psychological stressors as well (Bartholomew, 2000; Rejeski et al., 1992; Sparling et al., 2003). It is for these reasons that exercise has often been examined as a treatment for stress. An acute bout of aerobic exercise was shown to be effective at decreasing levels of stress (Rejeski et al., 1992). Studies also found that participants reported that a single session of exercise could be useful for enhancing a sense of stress-resistance (Roth, 1989), which suggests that it may reduce responses to the stress of social rejection. Not only is exercise believed to be effective at diminishing anxiety and stress but it has also been investigated as a treatment for depressed feelings, which can be a result of social rejection.

Exercise – Depression

Depressed feelings and sad mood are often the result of social rejection. Ways to effectively reduce these feelings and mood are continually sought after. Researchers have investigated the ability of exercise and exercise programs to treat depressed feelings. Exercise was found to significantly reduce depression score as well as reduce depressed and negative

mood, (Lane & Lovejoy, 2001; Rethorst, Wipfli, & Landers 2009; Yeung & Hemsley, 1995). Significant mood improvement was found regardless of the initial emotional state of the participants; indicating the robust ability of exercise to improve mood (Lane & Lovejoy, 2001). Research has demonstrated the effects of exercise extending from depression treatment to general affect improvement. Depressed mood and sad feelings are often the results of social rejection. If exercise is able to treat these moods and emotions, the question then becomes, does exercise reduce hurt feelings after social rejection?

Rejection and Aggression

In addition to looking at responses to rejection, there is also a literature looking at the effects of rejection on behavior. One such behavior is aggression. It has been demonstrated that physical pain elicits aggression, and "aggression in response to pain is an important aspect of the fight response to threats of safety" (MacDonald & Leary, 2005, p. 209). Social pain theory states rejection is a threat to safety, allowing aggression to be a reasonable defensive response. Criminal and antisocial behavior, rates of divorce, living alone, and lack of belongingness are positively correlated (Twenge, Baumeister, Tice, & Stucke, 2001). When people are unable to fulfill the "need to belong," aggression has been observed as a result (Leary & Baumeister, 2000). The lack of belongingness or rejection is one of the most common precursors to aggression (Leary, Twenge, & Quinlivan, 2006). Twenge et al., (2001) demonstrated the connection between social rejection and aggression through multiple studies. For example, in one of these studies, the investigators manipulated social exclusion by informing participants that after a group interaction nobody wanted to work with them, (Leave One Out Task) and had rejected them as a partner for a group task. These manipulations resulted in the participants behaving more aggressively than those who were not rejected. Not only did participants aggress

specifically towards an identified target but also neutral persons as well. The studies suggested "being alone is in some respects worse than having your bones broken" (Twenge et al., 2001). Given the overlap between social and physical pain, and the likely response to aggress given the threat to oneself, it is plausible to assume aggressive behavior will occur as a result of social rejection.

Exercise Effects on Social Rejection and Rejection-Triggered Aggression

The literature on the mood effects from exercise is converging towards homogenous findings. Exercise is continually investigated for its potentially beneficial underlying psychological mechanisms. Little research has been conducted on how exercise effects social rejection and rejection triggered aggression– emotions that plague us every day. Studies have demonstrated the powerful effects of exercise on increasing positive mood and decreasing depression, anxiety, and stress; suggesting that exercise might have an effect on hurt feelings after social rejection? We hypothesize that a session of cardiovascular exercise will reduce feelings of social rejection and rejection-triggered aggression. The goal of this study is to investigate and further understand the effects of exercise on social exclusion and aggression and its ability to alter emotions.

Overview of Present Research

In two experiments, we tested the impact of cardiovascular exercise on social rejection and rejection-triggered aggression. The two experiments varied the rejection paradigm and the aggression measure. The frequency at which participants exercised was a self-reported measure in study 1, whereas in study 2 participants engaged in cardiovascular exercise. In study 1, participants were excluded by two other players in an online ball-tossing game, Cyberball, and then answered a questionnaire measuring threatened needs. In study 2, participants completed a

session of cardiovascular exercise, followed by a get to know you task. They were then excluded or accepted by 2 or 3 other participants and aggression was measured by the amount of hot sauce allocated. The rejection paradigm was changed to the Leave One Out Task, described above, because we believed the effects would be stronger for a smaller sample.

The hot sauce task was chosen as the measure for aggression in study 2 because it provided a readily available cover story: that we were investigating the effects of exercise on food taste and choice. Giving someone who doesn't like hot sauce more hot-sauce to eat is a face-valid measure of aggression as exemplified in movies such as the cayenne pepper scene in "Mrs. Doubtfire," as well as similar aggressive acts documented in restaurants (Lieberman, 1999). Amount of hot sauce is easily quantifiable, and ecologically valid (Lieberman, 1999). The weight of hot sauce containers can easily be weighed to quantify aggressive intent,

Study 1

Method

Participants and Design

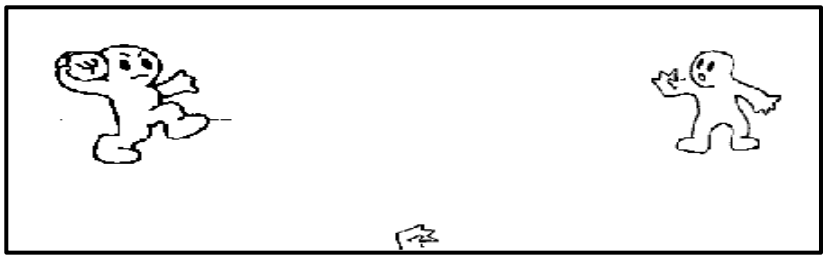
Two hundred and fifty-eight people (121 female) participated in the online experiment that was posted on the MTurk website. All participants were in the exclusion condition, receiving one toss out of forty during the Cyberball game.

Materials

The baseline questionnaire (Appendix A) assessed demographic information, mood, marijuana use, and exercise frequency. The Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985) was used to measure self-reported frequency of exercise. This questionnaire asked participants how many times in a 1-week period they exercised for more than 15 minutes across three levels of exercise intensity: strenuous, moderate, and mild, as well as how often they

work up a sweat during any activity during a 1-week period. Total weekly exercise was calculated using the following formula: (9 X Strenuous) + (5 X Moderate) + (3 X Mild)

To induce hurt feelings, participants played a game of Cyberball (Figure 1).



Cyberball is a ball toss program developed to study social ostracism and acceptance (Williams, Yeager, Cheung, & Choi, 2012). In brief, participants are led to believe they are playing an online game of catch with other participants over the computer. A Cyberball game link was programmed to run after the survey questions. The number of players, tosses, and to whom those tosses go to can be written through a script. The script and images were then uploaded through the Inquisit program. For the purpose of this study Cyberball was programmed for participants to receive only the first out of forty tosses.

To assess hurt feelings, an eight-item version of the Need Threat Scale (NTS; Jamieson, Harkins, & Williams, 2010; Appendix B) was used. Thus each of four psychological needs was assessed with two items: belonging (I felt disconnected; I felt rejected); esteem (I felt good about myself; I felt liked); meaningful existence (I felt invisible; I felt meaningless); and control (I felt powerful; I felt I had control over the course of the interaction). Participants rated their responses on a 1 to 5 scale ranging from not at all to extremely. On the same scale, participants also responded to two questions assessing anger: “I felt annoyed” and “I felt angry.”

To assess aggressive intent, participants completed four questions such as “How much do you want to punish the other players?” Answers on a 5-point scale ranged from “not at all” to “an extreme amount”.

To check the degree of deception, participants were asked "to what degree did you think you were playing other people over the Internet?" Answers were on a 5-point scale ranging from "not at all" to "very likely".

Procedure

All of the materials were set up through a survey link and posted on Amazon's MTurk website. The purpose of the study was advertised as examining "how different aspects of personality influence how people relate to each other." clicked on the link to load the survey. After answering the demographics questionnaire, they clicked on another link to load the Cyberball game. They then received the first toss of the ball, clicked on another participant to toss the ball to and then had to wait as the remaining thirty-nine tosses were thrown between the other two players. Upon the completion of Cyberball the participants answered the questionnaire assessing hurt feelings, feelings of aggression, and the degree to which they were deceived. Participants were paid $1 USD as compensation for their participation.

Analyses

Analysis was conducted using the "total weekly exercise" value on the Godin exercise questionnaire. Participant's responses to the 8-item Need Threat Score (NTS) were averaged into a composite score. The 4 questions measuring aggression were analyzed separately, as well as averaged into a composite score.

Results

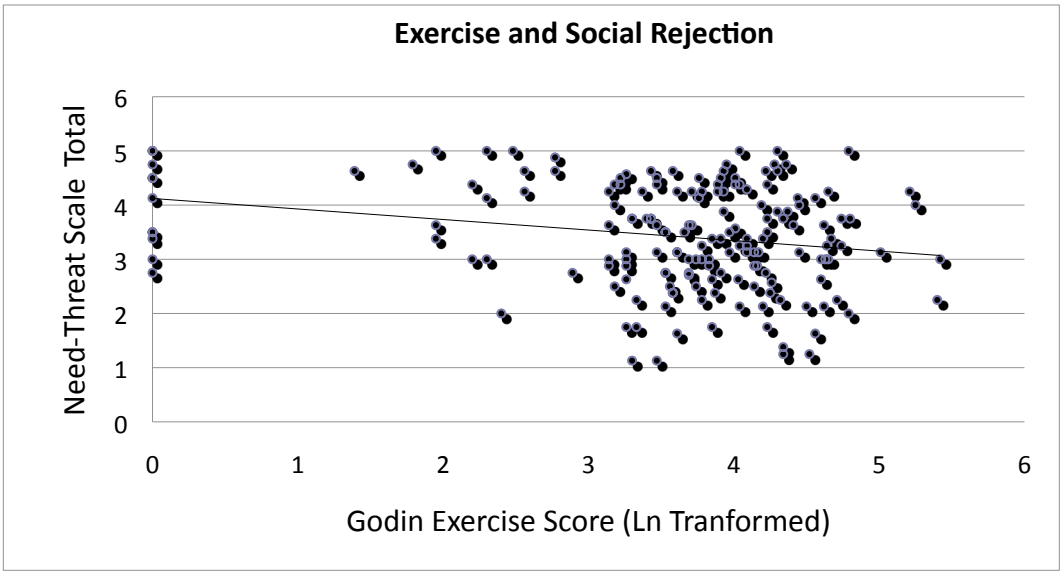
258 people participated in the online study. For the purpose of data analysis participants who responded with greater than 30 for the strenuous or moderate exercise categories were dropped from the analyses (n=11) because the questionnaire was completed incorrectly.

Participants reporting that they were at least possibly deceived (responses greater than or equal to 2 (n=172) on the deception measure) were used for the analysis.

Exercise

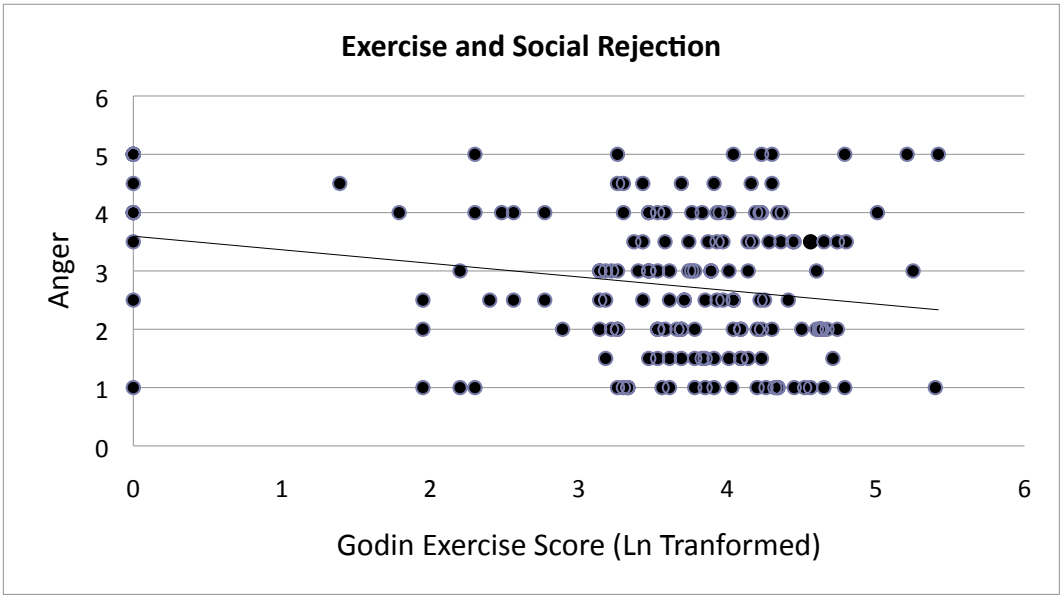
To examine the effects of self-reported exercise on NTS scores a correlation was performed. There was a negative correlation between NTS and Godin Exercise score ($r(167) = -.24$, $p = .002$; Figure 2). These effects also remained significant if all participants were analyzed ($r(244) = -.15$, $p = .018$).

Figure 2



To examine the effects of self-reported exercise on feelings of anger and aggressive intentions, correlations were also performed. There was a negative correlation between Godin Exercise score and anger ($r(167) = -.22$, $p = .004$; Figure 3), which was also significant in the full sample ($r(244) = -.13$, $p = .046$). There was no relationship between Godin Exercise score and aggressive intentions ($r(167) = .027$, $p = .73$).

Figure 3



Study 1

Discussion

As hypothesized, participants who reported exercising more often had lower scores on the Need Threats Scale, indicating they were less affected by the social rejection. Participants who reported exercising more also had lower anger scores after being rejected. There was no correlation between exercise and aggressive intentions.

The results support the hypothesis that exercise provides the ability to buffer against the feelings of social rejection, and anger. Participants exercising frequently had lower scores on NTS, furthering the connection between exercise and its mood boosting abilities.

The lack of correlation between exercise and aggressive intentions could be due to several reasons. First, there may have just not been a desire to aggress from the participants. It is possible that there was no correlation with aggressive intentions because we measured only the intention rather than the actual behavior. Participants may have also not felt the need to aggress

since the rejection was online, rather than in person, making it difficult to develop the aggressive intentions without a physical presence.

While the results from the study were significant in demonstrating the connection between the buffering effects of exercise on feelings of social rejection and anger, it is only correlational. We wanted to determine if there was a causal effect of exercise and if the results could be replicated in an experimental study as tested in study 2.

Study 2

Method

Participants and Design

Participants were forty-two (16 female; 14 white, 1 black, 1 Indian) undergraduate students enrolled in an introductory psychology course and the Research Experience Program (REP). To participate in the study subjects must have been partaking in at least 30 minutes of cardiovascular exercise, at least 4 times a week, for the past 6 months. Random assignment to both the exercise and rejection conditions was used. Twenty-two participants (nine female) were assigned to the high exercise condition, twenty participants (seven female) to the low exercise (control) condition. Twenty-one participants (eight female) were rejected after the group interaction, and twenty-one participants (eight female) were not rejected after the group interaction.

Materials

Four questionnaires were distributed at specific times throughout the experiment. The baseline questionnaire (Appendix C) consisted of six demographic questions, the Godin Leisure-Time Exercise Questionnaire (Godin & Shephard, 1985), Cohen's 4 item perceived stress scale (Cohen, Kamarck, & Mermelstein, 1983), as well as 14 questions measuring affect. The

affective adjectives were summed into 5 categories, which were: Inclusion: accepted, connected, valued, abandoned (reverse scored); Sadness: sad, dejected; Anger: angry, irritated; Positive Affect: happy, cheerful; Stressed: stressed, tense, calm (reverse scored), relaxed (reverse scored). These 14 adjectives were measured at baseline, after the exercise manipulation, and after the rejection manipulation to see how they changed as a function of the procedures. Responses were measured on a 7-point scale ranging from "not at all" to "very much".

The post-exercise questionnaire (Appendix D) consisted of Cohen's 4 item perceived stress scale, and the 14 questions measuring affect.

The post-group interaction (Appendix E) questionnaire assessed affect and closeness to the group as well as several questions to set-up the hot-sauce manipulation. Affect was measured with a single item: "How do you feel right now?" Participants made a mark across a 100mm line that was anchored on the left with the word "negative" and on the right by the word "positive." Closeness to the group was measured two ways. The first was the Perceived Group Reinforcement Scale (PGRS), (α = .98) (Creswell, Sayette, Manuck, Ferrell, Hill, & Dimoff, 2012). The PGRS included questions such as "The members of this group are interested in what I have to say." Responses were recorded through a 9-point scale ranging from "strongly disagree" to "strongly agree." The second measure of group closeness used a modified version of the Inclusion of other in Self Scale (Aron, Aron, & Smollan, 1992) designed to assess how close the participant felt to the group.

As a setup for the rejection manipulation, participants completed the group preference sheet (Appendix E), which stated, "We are interested in forming groups in which the members like and respect each other. Below, please name the two people (out of those you met today) you would most like to work with." To facilitate the post-rejection measure of aggression, a food

preference sheet (Appendix E) was also included, which asked participants to rate their preference for sweet, sour, hot and spicy, and salty foods on a 1 (strong dislike) to 21 (strong liking) scale.

The post-rejection questionnaire (Appendix F) included the same single item affect measure as after the group interaction as well as the 14 questions measuring affect.

To monitor heart rate, particularly during the exercise sessions, each participant wore Polar Heart Rate Monitors for the duration of the study.

Procedure[1]

Participants were brought into the lab (in groups of 3-4) and chose their own private room. They were informed that the study was "investigating teamwork without previous interaction and only minimal prior knowledge of one's partner. Most studies assign participants to groups and observe them, but this is not often how teams form and work in real life. To study teams in a more naturalistic way, we are collecting data in which team members choose their own teams. Because teamwork is an important part of many sports we are looking at how exercise affects this." Participants were also told that as part of the team task they would later be completing we were also examining food preference because appetite and exercise are often linked.

After consent was given, each participant was fitted with a polar heart rate monitor. The baseline questionnaire was administered and upon finishing the questionnaire each participant was informed if they were in the "high heart rate exercise condition" or the "low heart rate exercise condition". Those in the low heart rate condition were instructed to remain in the experimental room and maintain their current heart rate. They were allowed to study, text, or

[1] Specific wording included in the protocol in Appendix G

surf the web. For those in the high heart rate condition, the experimenter accompanied them to the Recreational and Physical Activity Center (RPAC). They had their choice of using either a stationary bike (n=10) or treadmill (n=12). They were instructed to exercise for 45 minutes, with a heart rate of 140-160 bmp, after a 5-minute warm up period. Once the exercise session was complete, participants returned to the lab and all participants completed the post-exercise questionnaire in an individual room.

For the subsequent group interaction, all participants were seated in a circle in the same room. The researcher instructed the participants to learn each other's names, and that it would be important for the following task. They were then instructed to talk amongst themselves for 10-15 minutes to get to know each other. A question sheet to prompt discussion was provided.

After the discussion, participants were then instructed to return to their rooms and completed the post-group interaction questionnaire. Once completed, the researcher collected all of the questionnaires and told each participant she would return shortly after determining the partner matches based on each participant's preferences.

Participants were randomly assigned to inclusion and exclusion conditions. Participants in the inclusion condition were told: "I have good news for you – everyone chose you as someone they'd like to work with. Because we cannot have groups of 4 people, you will complete the food task alone though. Here is the food preference sheet from another group member, you will now complete the food task." Participants in the exclusion condition were told "Usually what I do is look at those sheets everyone filled out saying who they want to work with. This time what happened is no one chose you. So… because of that you will have to complete the rest of the study alone."

To measure aggressive behavior, all the participants were given an identical food preference sheet, which they believed was completed by another participant. Participants then selected from two envelopes a slip of paper indicating their "condition" and "assignment" for the subsequent task. In actuality, all participants were in the "hot and spicy" condition, and were assigned as a "preparer" for the food. All participants were then instructed to allocate hot sauce into the plastic container for the other participant to consume.

Upon completion of the hot sauce task, participants then completed the final questionnaire. Before leaving participants were given a funnel debriefing to determine if they suspected the deception or not. Participants were asked in sequential order: (1) "Are you wondering anything about this experiment, or do you have any questions about it? (2) What do you think the experiment was about? (3) When you were told no one wanted to work with you, did anything stand out? and (4) Did anything about the experiment seem strange to you, or was there anything you were wondering about?" The level of deception of the participant was then recorded using one of three levels of deception: (1) not deceived; (2) most likely deceived; and (3) definitely deceived.

Analyses

Composite scores were created for each of the specific affective measures. To compare the effects of the manipulations on affect ratings, change scores were calculated by subtracting the baseline ratings from the post-exercise, or post-rejection manipulation, respectively. For the assessment of the effects of exercise, a one-way ANOVA was used. To assess the effects of the exercise and rejection manipulations, two-way ANOVAs were calculated. In the case of significance, simple effects analyses were done to interpret the nature of the interaction. All analyses were conducted with the statistical software program SPSS (Version 20).

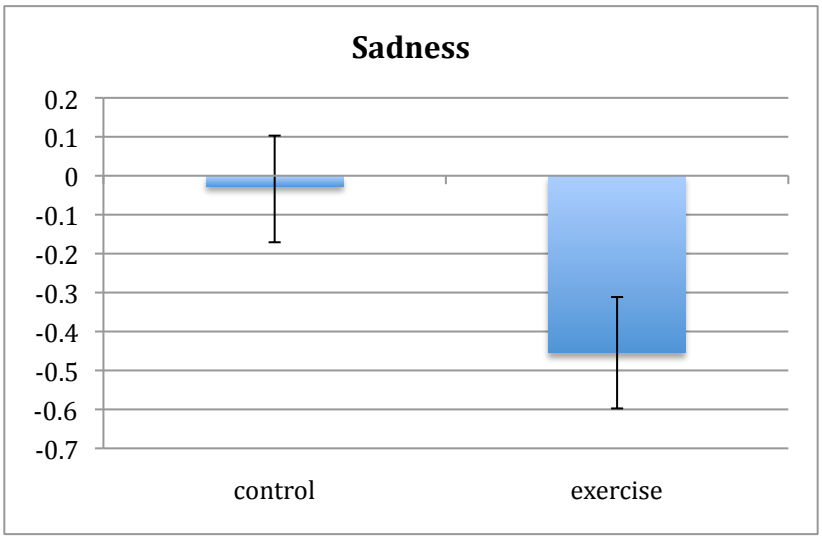
Results

Of the 42 participants, one was rated as not deceived and excluded from subsequent analyses. Another participant was excluded prior to analyses, as they did not meet the inclusion criteria of exercising 30 minutes, 4 times a week, for the past 6 months, leaving 40 participants for analysis. There were no significant differences in baseline affective measures between conditions (stress, $p > .547$; anxiety, $p > .967$; inclusion, $p > .153$; sadness, $p > .520$; anger, $p > .495$; positive affect, $p > 1.000$), indicating that the randomization procedure was successful.

Exercise

To determine the effects of exercise on affect, an ANOVA was run with exercise condition as the independent variable and affect (post-exercise minus baseline) as the dependent variable. Results showed there was a significant decrease in sadness right after the period of exercise, ($F(1,38) = 4.664$, $p = .037$; Figure 4), as well as anger ($F(1,38) = 8.712$, $p = .005$; Figure 5). There were no significant effects on changes in perceived stress ($F(1, 38) = .355$, $p = .555$), inclusion ($F(1, 38) = 1.627$, $p = .210$), anxiety ($F(1, 38) = .000$, $p = .991$) or positive affect ($F(1, 38) = 1.096$, $p = .302$). The act of cardiovascular exercise for a period of 50 minutes appears to have reduced self-reported anger and sadness, but did not affect anxiety, positive affect, or feelings of inclusion.

Figure 4



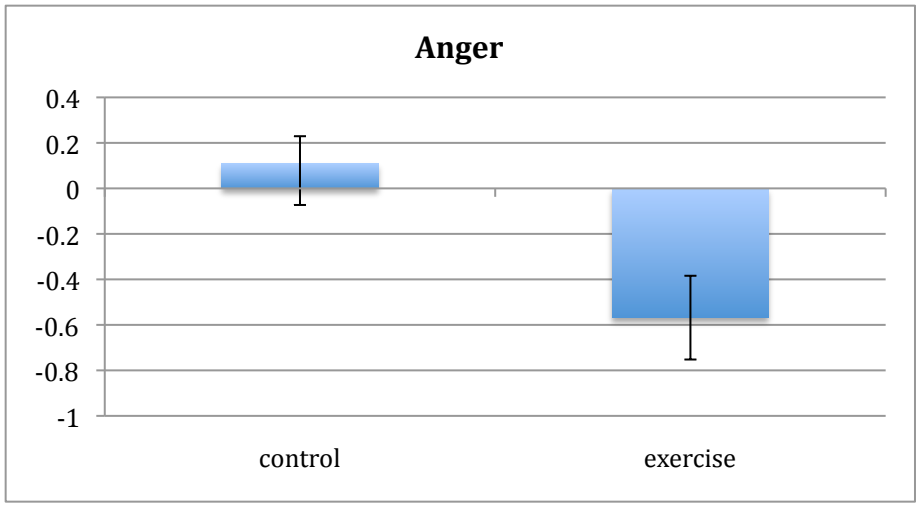


Figure 5

Rejection

To examine the effects of rejection and the interaction between rejection and aggression, a 2-way ANOVA was run with rejection condition and exercise condition as independent variables and change in affect (post-rejection minus post-exercise) as the dependent variable. Baseline affect was a covariate in these analyses.

For feelings of inclusion, there was a robust main effect of the rejection condition ($F(1,35)=37.76$, $p < .001$) and no main effect of the exercise condition ($F(1,35)=.47$, $p =.5$). There was a significant interaction between the exercise and rejection condition ($F(1,35)=4.17$, $p = .049$; Figure 6). Simple effects analyses showed that the effect of rejection condition was significant in both the no exercise group ($p < .001$) as well as the exercise group ($p =.004$). Participants who were rejected had a

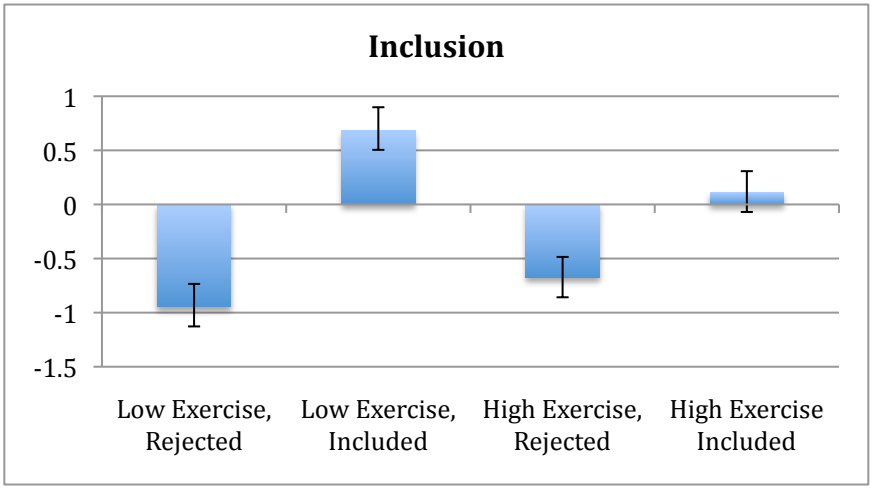
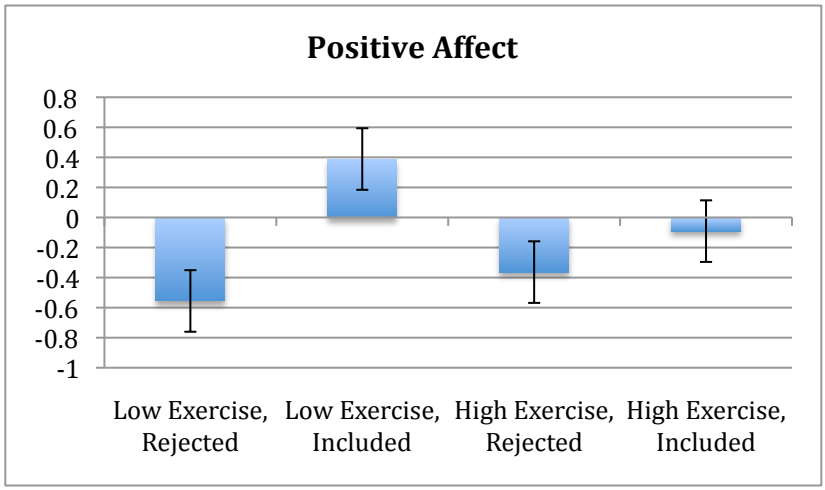


Figure 6

difference in mean (post-rejection minus post-exercise) of -.9444. Participants who were not rejected had a significant difference in mean of .6875. The mean difference of participants who did exercise was -.6750 (rejected), and .1136 (not rejected).

Similar effects were seen for positive affect. There was a main effect of rejection condition ($F(1,35)=7.5$, $p = .009$) and a trend for an interaction between rejection and exercise condition ($F(1,35)=3.48$, $p = .071$; Figure 7). Simple effects analyses indicated that the rejection manipulation was significant only in the non-exercise condition ($p = .004$).

Figure 7



For negatively valenced emotions, the direction of effects went in the opposite direction. There was a main effect of rejection on sadness ($F(1,35)=21.15$, $p < .001$), but no main effect of exercise on sadness ($F(1,35) = .57$, $p = .46$). The main effect of rejection was conditioned by an interaction between exercise and rejection ($F(1,35) =10.54$, $p = .003$; Figure 8). Tests of simple effects showed that the rejection manipulation

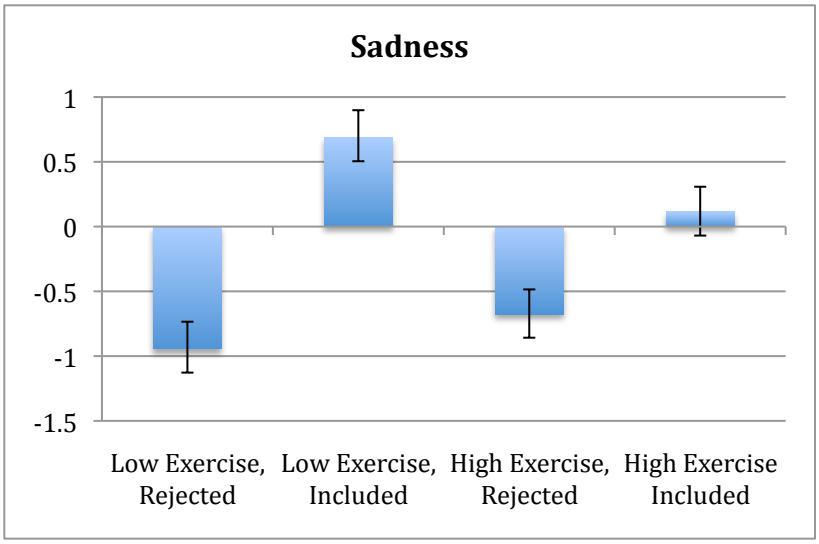
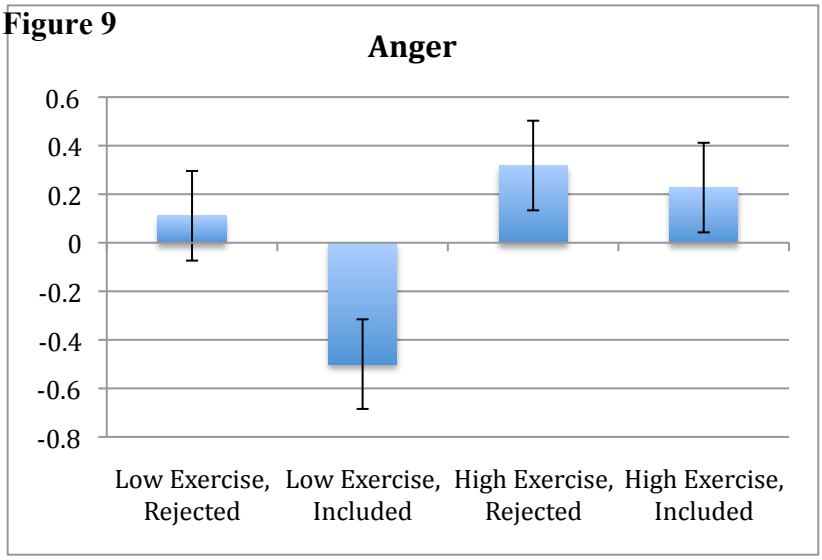


Figure 8

only had effects in the control condition (p = < .001) and not the exercise condition (p = .35). Conversely, when the simple effects of exercise were looked at in the inclusion condition, there was a significant effect of exercise in the inclusion condition (p = .008), while only a trend in the rejection condition (p = .081). Participants who were rejected had a mean difference of .8889, and those not rejected had a mean difference of -.8125. The mean difference of participants who did exercise was .3000 (rejected) and .1818 (not rejected). Thus, it appears that exercise blunts reactivity to both the sadness-reducing effects of inclusion and to a lesser extent the sadness inducing effects of exclusion. Participants in the control condition were more reactive to the effects of the social interaction.

Feelings of anger showed a slightly different pattern. There was a marginally significant effect of the rejection condition on anger (F(1,35)=3.39, p = .074) and a significant main effect of exercise condition (F(1,35)=5.54, p= .024; Figure 9). The mean levels of anger were higher in the group that exercised (M=.27; SD=.65) than in the group that did not (M = -.19; SD = .66).

Figure 9



There was no interaction effect between the two conditions (F(1,35)=.95, p =.34). When the anger report at baseline was used as the reference (post-rejection minus baseline), there was not a significant main effect of exercise (F(1,35) = .86, p = .36) but was a marginally significant main effect of the rejection condition (F(1,35)=3.44, = .072). There was no interaction (F(1,35)=.058, p = .81). This

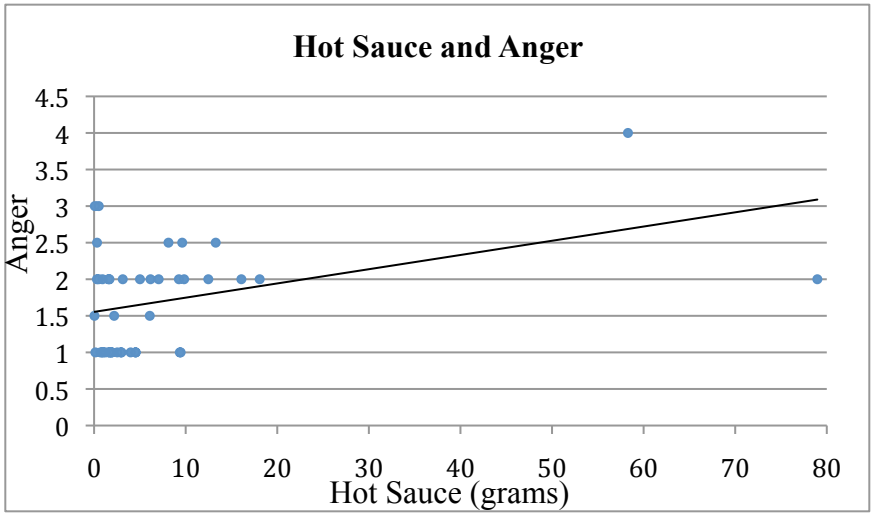
suggests that the main effect of an increase in anger after the social interaction was regression to the mean.

There were no main or interaction effects for anxiety (p's > .2).

Aggression

To assess the degree to which rejection triggered aggression was moderated by having exercised, the amount of hot sauce allocated to a member of the group was measured. There was a significant correlation between the final report of anger and hot sauce allocated (r(38) = .39, p = .013; Figure 10). However, the weight of hot sauce allocated had two significant outliers (>3 SD). When they were excluded from the analysis, the relationship was no longer significant (r(36)=.2, p = .22).

Figure 10



To examine the effects of rejection and exercise on hot sauce allocation a two way ANOVA was performed. There was no main effect of exclusion (F(1,34) = .083, p = .77), exercise (F(1,34)=.002, p = .97) or their interaction (F(1,34) = 1.02, p = .32). These results did not change if the analyses were re-run with the two outliers included or with preference for hot and spicy foods as a covariates of gender or preference for hot-and-spicy foods.

Study 2

Discussion

As hypothesized, participants who exercised for a period of 50 minutes did experience post-exercise mood effects, as shown by reductions in ratings of sadness and anger. These findings appear to further support the literature on the positive effects of exercise.

The rejection paradigm was successful at eliciting the feelings associated with social rejection. Participants in the rejection condition felt less included and less positive, with ratings of sadness and anger increased. Thus, there does not appear to be a numbing effect of rejection, as has been reported by others (DeWall, Baumeister, Masicampo 2009).

As for the main research question, there were several interactions between the exercise and rejection conditions. These interaction effects showed a consistent pattern for measures of inclusion, positive affect and sadness. It must be noted that the greatest amounts of change in all three of the affective measures were the participants in the group that did not exercise. Indicating inclusion or rejection had a greater impact on mood if the participant had not exercised. The least amount of change in affective scores was observed in the exercise condition. Indicating that being informed of social inclusion or rejection did not alter the mood state of the exercising participants.

The results of the exercise, rejection and affect interactions have several possible explanations. The participants in the no exercise group had the greatest change in affect post-rejection. The participants in the exercise condition did not have much change in affect, regardless if they were rejected or included. These results may indicate that the period of exercise resulted in the activation of a system that buffers against any emotional change, regardless if it is positive or negative. Regardless of the underlying process, the results indicate that exercise aided against the news of rejection, however further research will be necessary to unpack the mechanisms.

One of the most unexpected findings was the increase of in anger after the social interaction by the participants who had exercised. Feelings of anger were reduced post-exercise, however they increased after the social interaction. It appears that there were no differences in anger between the baseline condition and the post-social interaction, suggesting that the increase in anger seen is likely to be due to regression to the mean in a small sample.

While there were significant increases in post-rejection anger, they did not carry over into an actual act of aggressive behavior, as measured by the allocation of hot-sauce. Overall, it did not appear that the hot-sauce manipulation was a particularly sensitive measure.

The significant increases of anger after the social interaction contradict our findings that exercise reduces anger. It is possible that exercise causes anger to increase with rejection, however this explanation negates the findings of reduced anger post-exercise. One potential explanation for this post-interaction rise in anger would be excitation transfer. Excitation-transfer theory states, "Residual excitation from essentially any excited emotional reaction is capable of intensifying any other excited emotional reaction" (Zillmann, 2006, p. 223). This theory then explains how one emotion can then be transferred or expressed as another emotion. Zillmann (1998) found that when participants exercised for a brief period, aggressiveness on subsequent tasks. It could be possible that our participants misattributed the arousal from the exercise period as anger. This would then explain the significant increase in anger reported in the exercise condition.

Although measures indicated that feelings of anger increased, aggressive behavior did not. It is possible that exercise some how buffered against aggressive behavior. This lack of aggression could be due to the lack of desire to act upon the feelings of anger, or that the hot sauce task was not deemed an appropriate way to aggress by the participants. Because the no

exercise rejection condition is similar to prior work that has demonstrated an effect of the rejection manipulation on aggression (Twenge et al., 2001), it may be that the manipulation was not successfully implemented. It is also possible that exercise undermines the rejection-triggered aggression link. If exercise boosts mood and buffers against the hurt feelings associated with social rejection, then exercise could also buffer against rejection-triggered aggression. The excitation transfer theory of aggression observed in study two could support this as well, indicating that there wasn't a true increase of anger, but rather a misattribution of the arousal. This would all lead to buffering effects of exercise with social rejection and rejection-triggered aggression.

While the results of the study indicate strong evidence for the effects of exercise to elevate mood, and buffer against some feelings of social rejection, further research is required to understand the increases of anger.

General Discussion

Both studies offer strong evidence of the effects of exercise on buffering responses to social interactions. Exercise appears to be a method to combat sad feelings, and lack of belongingness after social exclusion. The studies were not conclusive with respect to the effects of exercise on anger. Although there was significantly less anger in study 1 for those who exercised regularly, there was not a clear effect in study 2. Future research could clarify the discrepancy found between post-rejection anger levels in the two studies. Whether or not the increase in anger after combining social interaction and exercise is due to excitation transfer effects or not, will need to be clarified in future research.

The lack of aggressive intentions or aggressive behavior (study 2) found in these studies should be investigated further. Not having a measure of aggressive behavior in study 1 is a

limitation. In study 2, it is not clear whether the lack of aggression is due to methodological issues or exercise undermining the rejection-triggered aggression link, but only future research will tell.

While the studies were unable to find conclusive evidence regarding aggression, the measures indicated exercise as an effective tool for combating hurt feelings after social rejection. While exercise is not a cure-all solution it has been demonstrated as a powerful method to combat issues that plague people every day.

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Appendix A

Study 1 Baseline Questionnaires

1. What is your gender?
____ Male
____ Female

2. What is your age? ____

3. What is your ethnic background? _____

4. What is your current place of residence? (City and country)? _____

5. What is your birthplace? (provide zip code if in the US _____

6. Where were you raised? (provide zip code if in the US _____

7. What is your **natural** hair color (i.e. without dye)?

_____ Blonde
_____ Brown
_____ Black
_____ Red
_____ Sandy-blond
Other_____

Considering a **7-Day Period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (circle the appropriate number of times).

a) **Strenuous Exercise (Heart beats rapidly)** (i.e. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

0 1 2 3 4 5 6 7 or more

b) **Moderate Exercise (Not exhausting)** (i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

0 1 2 3 4 5 6 7 or more

c) **Mild Exercise (Minimal effort)** (i.e. yoga, archery, fishing from river band, bowling, horseshoes, golf, snow-mobiling, easy walking)

0 1 2 3 4 5 6 7 or more

Considering a **7-day period (a week)**, during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)? (Circle one)

Often Sometimes Never/Rarely

Please rate the following statements using the scale below

1. **A man has the right to act with physical aggression towards another man who openly flirts with his wife.**
   1 2 3 4 5
   Not at all Some what Very much

2. **A real man never leaves a score unsettled.**
   1 2 3 4 5
   Not at all Some what Very much

3. **A man has the right to act with physical aggression toward another many who vandalizes his home.**
   1 2 3 4 5
   Not at all Some what Very much

4. **A real man never lets himself be a "door mat" to other people.**
   1 2 3 4 5
   Not at all Some what Very much

5. **A man has the right to act with physical aggression toward another man who slanders his family.**
   1 2 3 4 5
   Not at all Some what Very much

6. **A real man doesn't let other people push him around.**
   1 2 3 4 5
   Not at all Some what Very much

During the past 30 days, how many times did you use marijuana?

____ 0 times
____ 1 or 2 times

____ 3 to 9 times
____ 10 to 19 times
____ 20 to 39 times
____ 40 or more times

When was the last time you used marijuana? _____

Please rate the following statements using the scale below

1. How lonely have you felt over the last 30 days?

1	2	3	4	5
Not at all		Some what		Very much

2. Overall, how positively do you feel about yourself?

1	2	3	4	5
Not at all		Some what		Very much

3. Thinking about your life in general, how well are things going?

1	2	3	4	5
Not at all		Some what		Very much

4. How optimistic are you about your life in general?

1	2	3	4	5
Not at all		Some what		Very much

Appendix B

Please rate the following statements using the scale below.

1. I feel "disconnected"

1 2 3 4 5
Not at all Moderately An extreme amount

2. I feel rejected.

1 2 3 4 5
Not at all Moderately An extreme amount

3. I feel annoyed.

1 2 3 4 5
Not at all Moderately An extreme amount

4. I feel angry.

1 2 3 4 5
Not at all Moderately An extreme amount

5. I feel good about myself.

1 2 3 4 5
Not at all Moderately An extreme amount

6. I feel powerful.

1 2 3 4 5
Not at all Moderately An extreme amount

7. I feel liked.

1 2 3 4 5
Not at all Moderately An extreme amount

8. I feel invisible.

1 2 3 4 5
Not at all Moderately An extreme amount

9. I feel meaningless.

1 2 3 4 5
Not at all Moderately An extreme amount

10. I feel I had control over the course of the interaction.

1 2 3 4 5
Not at all Moderately An extreme amount

11. How much do you want to punish the other group members?

1 2 3 4 5

Not at all Moderately An extreme amount

12. How much do you want to help the other group members?

1 2 3 4 5
Not at all Moderately An extreme amount

13. How much do you want to harm the other group members?

1 2 3 4 5
Not at all Moderately An extreme amount

14. How much do you want to hurt the other group members?

1 2 3 4 5
Not at all Moderately An extreme amount

To what degree did you think you were playing other people over the internet?

A. not at all
B. Possible, but not likely
C. Possible
D. Possible, and fairly likely
E. Very likely

Appendix C

Date:_____ Participant: _____

Instructions: Please answer the following questions. All information that you provide will remain confidential, and feel free not to answer any questions that you feel uncomfortable in completing.

1. What is your gender?
____ Male
____ Female

2. How old are you? ____

3. What is your **natural** hair color (i.e. without dye)?

_____ Blonde
_____ Brown
_____ Black
_____ Red
_____ Sandy-blond
Other_____

4. What is your ethnicity/cultural background? _____

5. What is your mother's ethnicity/cultural background? _____

6. What is your father's ethnicity/cultural background? _____

Considering a **7-Day Period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your **free time** (circle the appropriate number of times).

a) **Strenuous Exercise (Heart beats rapidly)** (i.e. running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)

0 1 2 3 4 5 6 7 or more

b) **Moderate Exercise (Not exhausting)** (i.e. fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)

0 1 2 3 4 5 6 7 or more

c) **Mild Exercise (Minimal effort)** (i.e. yoga, archery, fishing from river band, bowling, horseshoes, golf, snow-mobiling, easy walking)

0 1 2 3 4 5 6 7 or more

Considering a **7-day period (a week)**, during your leisure-time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)? (Circle one)

Often Sometimes Never/Rarely

Please rate the following statements using the scale below.

1. I am able to control important things in my life.

1 2 3 4 5 6 7
Not at all Some what Very much

2. I feel confident about my ability to handle my personal problems.

1 2 3 4 5 6 7
Not at all Some what Very much

3. I feel like things are going my way.

1 2 3 4 5 6 7
Not at all Some what Very much

4. Difficulties are piling up so high that I cannot overcome them.

1 2 3 4 5 6 7
Not at all Some what Very much

Please use the following scale to rate how you are currently feeling.

1. I feel stressed.

1 2 3 4 5 6 7
Not at all Some what Very much

2. I feel accepted.

1 2 3 4 5 6 7
Not at all Some what Very much

3. I feel calm.

1 2 3 4 5 6 7
Not at all Some what Very much

4. I feel relaxed.

1	2	3	4	5	6	7
Not at all			Some what			Very much

5. I feel tense.

1	2	3	4	5	6	7
Not at all			Some what			Very much

6. I feel connected.

1	2	3	4	5	6	7
Not at all			Some what			Very much

7. I feel valued.

1	2	3	4	5	6	7
Not at all			Some what			Very much

8. I feel abandoned.

1	2	3	4	5	6	7
Not at all			Some what			Very much

9. I feel sad.

1	2	3	4	5	6	7
Not at all			Some what			Very much

10. I feel dejected.

1	2	3	4	5	6	7
Not at all			Some what			Very much

11. I feel angry.

1	2	3	4	5	6	7
Not at all			Some what			Very much

12. I feel irritated.

1	2	3	4	5	6	7
Not at all			Some what			Very much

13. I feel happy.

1	2	3	4	5	6	7
Not at all			Some what			Very much

14. I feel cheerful.

1	2	3	4	5	6	7
Not at all			Some what			Very much

Once you have completed this questionnaire, please open your door and wait for further instructions from the experimenter.

Appendix D

Date:_____ Participant: _____

Instructions: Please answer the following questions.

Please rate the following statements using the scale below.

1. I am able to control important things in my life.

1	2	3	4	5	6	7
Not at all			Some what			Very much

2. I feel confident about my ability to handle my personal problems.

1	2	3	4	5	6	7
Not at all			Some what			Very much

3. I feel like things are going my way.

1	2	3	4	5	6	7
Not at all			Some what			Very much

4. Difficulties are piling up so high that I cannot overcome them.

1	2	3	4	5	6	7
Not at all			Some what			Very much

Please use the following scale to rate how you are currently feeling.

1. I feel stressed.

1	2	3	4	5	6	7
Not at all			Some what			Very much

2. I feel accepted.

1	2	3	4	5	6	7
Not at all			Some what			Very much

3. I feel calm.

1	2	3	4	5	6	7
Not at all			Some what			Very much

4. I feel relaxed.

1	2	3	4	5	6	7
Not at all			Some what			Very much

5. I feel tense.

1 2 3 4 5 6 7
Not at all Some what Very much

6. I feel connected.

1 2 3 4 5 6 7
Not at all Some what Very much

7. I feel valued.

1 2 3 4 5 6 7
Not at all Some what Very much

8. I feel abandoned.

1 2 3 4 5 6 7
Not at all Some what Very much

9. I feel sad.

1 2 3 4 5 6 7
Not at all Some what Very much

10. I feel dejected.

1 2 3 4 5 6 7
Not at all Some what Very much

11. I feel angry.

1 2 3 4 5 6 7
Not at all Some what Very much

12. I feel irritated.

1 2 3 4 5 6 7
Not at all Some what Very much

13. I feel happy.

1 2 3 4 5 6 7
Not at all Some what Very much

14. I feel cheerful.

1 2 3 4 5 6 7
Not at all Some what Very much

Once you have completed this questionnaire, please open your door and wait for further instructions from the experimenter.

Appendix E

Date:_____ Participant: _____

Instructions: Please answer the following questions.

How do you feel right now?
(Please mark an X on the line)

_____
Negative Positive

Please rate the following statements using the scale below.

1. I like this group.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

2. The members of this group are interested in what I have to say.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

3. The members of this group value my ability to contribute.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

4. My presence makes a difference to this group.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

5. I see myself as an important part of this group.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

6. I am satisfied with this group.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

7. The members of this group underestimate my ability to contribute.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

8. I often disagree with the members of this group.
1 2 3 4 5 6 7 8 9
Strongly Disagree Strongly Agree

9. I feel included in this group.

1 2 3 4 5 6 7 8 9

Strongly Disagree Strongly Agree

10. In spite of individual differences, a feeling of unity exists in this group.

1 2 3 4 5 6 7 8 9

Strongly Disagree Strongly Agree

11. My presence is irrelevant to this group.

1 2 3 4 5 6 7 8 9

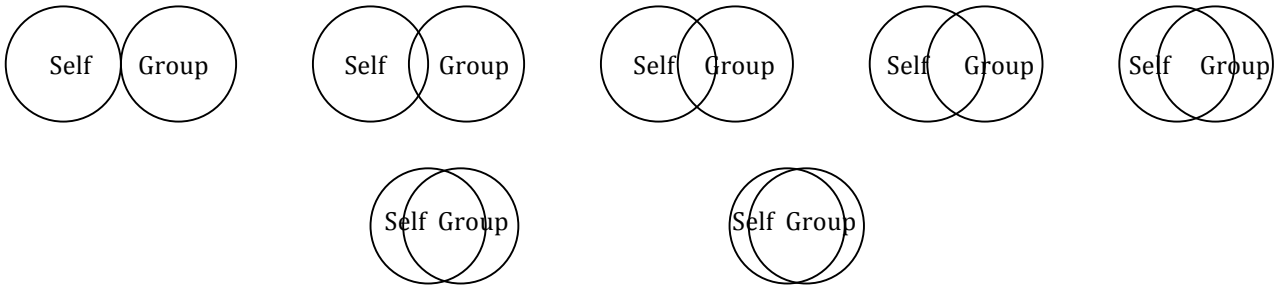
Strongly Disagree Strongly Agree

12. If an opportunity occurred outside this lab, I would look forward to being part of this group in the future.

1 2 3 4 5 6 7 8 9

Strongly Disagree Strongly Agree

Please ***circle the picture*** below that best describes your relationship with the group.



CHOICE OF GROUP MEMBERS

We are interested in forming groups in which the members like and respect each other. Below, please name the two people (out of those you met today) you would most like to work with:

_____

_____

Please write down the number of people (out of those you met today) who you believe will write down your name as some one they would most like to work with:

_____

FOOD PREFERENCES

Please indicate your preference for the following food types.

Sweet

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Strong Dislike Strong Liking

Sour

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Strong Dislike Strong Liking

Hot and Spicy

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Strong Dislike Strong Liking

Salty

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21
Strong Dislike Strong Liking

Once you have completed this questionnaire, please open your door and wait for further instructions from the experimenter.

Appendix F

Date:_____ Participant: _____

Instructions: Please answer the following questions.

Number of extra experiments
0 1 2 3

How do you feel right now? (Please mark an X on the line)

_____

Negative Positive

How much of your current feeling is due to something about you or something about the people you interacted with?

1	2	3	4	5	6	7
Totally due to me						Totally due to the others

Please use the following scale to rate how you are currently feeling.

1. I feel stressed.

1	2	3	4	5	6	7
Not at all			Some what			Very much

2. I feel accepted.

1	2	3	4	5	6	7
Not at all			Some what			Very much

3. I feel calm.

1	2	3	4	5	6	7
Not at all			Some what			Very much

4. I feel relaxed.

1	2	3	4	5	6	7
Not at all			Some what			Very much

5. I feel tense.

1	2	3	4	5	6	7
Not at all			Some what			Very much

6. I feel connected.

1	2	3	4	5	6	7
Not at all			Some what			Very much

7. I feel valued.

1 2 3 4 5 6 7
Not at all Some what Very much

8. I feel abandoned.
1 2 3 4 5 6 7
Not at all Some what Very much

9. I feel sad.
1 2 3 4 5 6 7
Not at all Some what Very much

10. I feel dejected.
1 2 3 4 5 6 7
Not at all Some what Very much

11. I feel angry.
1 2 3 4 5 6 7
Not at all Some what Very much

12. I feel irritated.
1 2 3 4 5 6 7
Not at all Some what Very much

13. I feel happy.
1 2 3 4 5 6 7
Not at all Some what Very much

14. I feel cheerful.
1 2 3 4 5 6 7
Not at all Some what Very much

Most people can be trusted.
1 2 3 4 5 6 7
Not at all Some what Very much

Most people are basically honest.
1 2 3 4 5 6 7
Not at all Some what Very much

Please read the scenario and choose an option.

A friend of yours of your own age has had two jobs offered to him/her. One job has a relatively high starting salary, but little promise of advancement or better income. The other job offers a starting salary that is considerably lower but with the possibility of substantial advancement and a much higher later income. Which job would you advise him/her to accept?

A. The job with the higher immediate salary

B. The job starting with the lower salary

How certain are you that this is what you would advise?

1	2	3	4	5	6	7
Not certain						Very certain

Once you have completed this questionnaire, please open your door and wait for further instructions from the experimenter.

Estimation: A _____ B _____

Appendix G

Specific Protocol

Running the Experiment (note: quotes to say from the script are in bold)

1. At the time for the experiment, go to the lobby and summon participants according to the guidelines on the REP Waiting Room Etiquette (The REP handout is under Google docs in the social neurochemistry Gmail account).

The critical points are to get the students attention and then according to their script:

"**Hello, I am calling participants for the REP Experiment "Exercise, Teams and Food."**

Lead the participants down the hallway to where the experimenter rooms are.

3. Introduce yourself to the participants by saying,

"**Hi, I am XXX and I'll be your experimenter today. Thank you for signing up for the Exercise, Teams and Food. This study is investigating partner teamwork without previous interaction and only minimal prior knowledge of one's partner. Most studies assign participants to groups and observe them, but this is not often how teams form and work in real life. To study teams in a more naturalistic way, we are collecting data in which team members choose their own teams. Because teamwork is an important part of many sports we are looking at how exercise affects this. Each of you will select a room and will then fill out the consent form on the desk, which describes this study. After that I will fit each of you with a heart rate monitor that you will wear for the duration of the study. You will then complete a few questionnaires about yourself and then proceed to the exercise portion of the study, which will be completed in the RPAC, or you will read quietly for the same duration of time. After the exercise portion is completed, we will all return back here and complete the team task. So each of you please select a room and fill out the consent form. The information you provide will be confidential. We will never attach your name to your responses. Your participation is voluntary and you will *receive two credit hours* for your participation in this study. In the interest of others, please refrain from texting or calling during the team and questionnaire portions of the study.**"

Note: If all participants show up (i.e. 5 rather than 4 participants), then pull one person aside and tell them that they free to go due to scheduling errors, but will still receive credit for the experiment.

Once everyone has completed the consent form, fit each participant with a heart rate monitor and take his or her resting heart rate. Mark this on the run sheet. After you have done this instruct them to fill out the first questionnaire. Close their door and tell them to open it upon completion. Once the participants have completed the questionnaire, inform them if they will be going to the RPAC or reading in their room (this will be on the run sheet).

4. If they are going to the RPAC say:
"We will now head over to the RPAC to complete the high heart rate exercise portion of the study, which will consist of a warm up period of 5 minutes, followed by 45 minutes at a heart rate of 140-160 beats per minute."

If they are in the control condition (aka "low heart rate exercise condition") and will be reading say:
"You will stay in your room and read for a period of 50 minutes. Try to keep your heart rate as it is now."

5. Walk the exercise participants over to the RPAC and get them set up on the treadmills or stationary bikes, then say:
"You will now begin the exercise portion of the study. Please get on the equipment and begin the 5-minute warm up period. At the end of the 5 minutes you should be running/cycling at a heart rate between 140 and 160 beats per minute. Continue to run/cycle within this range for the remaining 45 minutes."

Upon completion of the 50 minutes have all of the participants stop and walk them back to each of their rooms. Put on the white lab coat. The reason for this is that people have an implicit association of white lab coat with scientists and hence trustworthiness. This is to aid with the deception. The implicit message is: "A scientist would never lie to me, would they?" Instruct each of the participants to complete the second questionnaire, and then open their doors upon completion. Once all participants have opened their doors gather them in the group room and pass out the instructions for group interaction. Tell them:

6. "**In the next part of the study you will be talking as a group for about 15 minutes. The first thing you should do is learn each other's names – that is going to be important later on. So learn everyone's names. Here are some questions to get you started. You don't have to do all of them, and you don't have to do them in order. They are just some things that might help you start talking and getting to know each other. Just remember to learn each other's names. Any questions? Okay, I will be back in about 10-15 minutes."**

Leave the room and close the door.

7. After about 15 minutes have passed, open the door and come in the room and say:
"**Okay, for the next part of the experiment I'm going to take you to the other rooms."**
Put each participant in a room and tell them to fill out the third questionnaire, choice of group members sheet, and the food preference sheet.

Say:
"For the final portion of the study you will work with one of the of the other group members on a different task. While I am gone, please complete this sheet. Also, please fill out the sheet regarding your food preferences as well. Just so you know, this portion is probably going to involve a lot of waiting for you and a lot of running

around for me. In any case, I just ask that you be patient with me." (You will be running around, and they will be waiting around for what seems like to them an eternity, so it's good to apologize up front about it.)

8. Once the participants have completed the third questionnaire and open their doors, Say: **"Now I'm going to briefly leave to look at who would like to be paired up with whom, to determine the partners for this study's task."**

9. IMPORTANT: Check the social exclusion condition to which the participant has been assigned to on the participant's conditions sheet, and deliver the following feedback accordingly. This has to be ABSOLUTELY ERROR-FREE; otherwise the data of the participant is useless for us. If you change the condition, mark this on the sheet. In case you anticipate a big problem with the participant, put the participant into the control condition – here they can't do much damage. But mark this on the condition sheet.

Also make sure that the participant number on the sign-in sheet matches the participant number on the participant's condition sheet.

10. Return to each room and say either:
"Usually what I do is look at those sheets everyone filled out saying who they want to work with. (Sound subdued, even a little embarrassed) **This time what happened is no one chose you.** (Pause) **So… because of that you will have to complete the rest of the study alone. This will allow you to still receive credit for participating today."** (MEMORIZE!)

"Because you don't have a partner to work with you won't be doing the food tasting, but we still need you to prepare a sample for one of the other members of the group. Since you do not have a partner to work with for this food task, the preferences of one of the other participants have been randomly chosen for you to work off of. Here are their preferences." (hand them the info sheet. The preferences are indicated on a 21-point scale, with higher numbers indicating stronger preferences. The sheet they receive indicates a strong dislike ("3") for spicy foods.) **"**

OR

"I have good news for you – everyone chose you as some one they'd like to work with. Because we cannot have groups of 4 people you will complete the food task alone though. Here is the food preference sheet from another group member, you will now complete the food task."

11. Now for all of the participants:

"You will now draw a slip of paper from the *Assignment* bucket, as well as from the *Condition* bucket." (All of the slips say "preparer" and "Condition 2: Hot and Spicy") Once you see what their assignment and condition are say: **"Okay, I will be right back with the food."** Return with the hot sauce, cup and lid, spoon, and toothpicks.

"Please sample a small amount of the sauce (via a toothpick) **and then put as much hot sauce as you wish in the container for the other person, who will consume the <u>entire</u> sample. All quantities are helpful and you can put as much or as little as you want into the container. It will only be given to one person. Put a lid on the container and then open the door once you are finished."** (If they ask any questions about why you are going to do this, respond with something like: One of the things we are studying is food selection.") Leave the room while they allocate the sample. Once they have prepared the sample:
Thank you for your help with the food sample. This is the last questionnaire I need you to complete. If you would like you can just fill out the questionnaire, or if you can help out me and the other experimenters you can do some other experiments for us, each takes about 15 minutes and you could do one, two or three. Doing the other experiments won't affect the amount of credit you get. What you do is up to you. So please mark that on the first question of the questionnaire and then proceed with the rest of it. Please open your door once you have completed."

Once they open their door complete the time estimation. Say"
"We just have one last part. I'm going to let the stopwatch go for a certain amount of time and when I stop it I want you to tell me how much time passed. Please do not count or use your fingers to keep track of the time. We will do this twice. Please record your estimations in parts A and B."

The first time is 40 seconds; the second time is 80 seconds.

Once they have completed the time estimation begin the debriefing.

<u>Funnel Debriefing</u>
The point of the debriefing is to determine whether or not they were deceived by the manipulation. <u>This is an important consideration</u>, as it may have changed their responses to the task and we will want to limit our analyses to those who were deceived. Rather than just asking them outright, we ask a progressive set of questions. Usually you'll find that if they weren't deceived that is one of the first things they will say in response to the first vague questions.

When you see a participant open the door, go in and shut the door behind you so that individuals in the other rooms can't hear. Ask them the following questions:

Are you wondering anything about this experiment, or do you have any questions about it?
What do you think the experiment was about?
When you were told no one wanted to work with you, did anything stand out?
Did anything about the experiment seem strange to you, or was there anything you were wondering about?

Based on their responses to these questions, record whether or not you feel they were (the numbers reflect the amount of deception):

1 = not deceived at all
2 = probably deceived
3 = completely deceived

Record your response on the run sheet before going to the next room. Inform the participant that you will tell them more about the experiment in a minute you just need to go ask the same questions of the other participants.

Informational Debriefing:

Once all participants have received the funnel debriefing and you have an idea as to whether or not they were deceived, you can invite them out into the hallway and go through the Debriefing Script.

As part of the educational process, mention that we are interested in studying how exercise effects people's responses to rejection and how we think that the degree of response on has to being left out/rejected is associated with how they respond to physical pain, and that exercise causes the release of chemicals which should blunt feelings of rejection. Therefore we think that genes that control physical pain response are also controlling their social pain response.

Note: Also mention not to tell their classmates about the nature of the deception in the experiment.

Cleanup:

Remove the heart rate monitors from each participant after the informal debriefing.
Collect the questionnaires, double checking to make sure they were filled out with the appropriate participant number.
Make sure you give the students their appropriate credit.
Enter the information from the run sheet into the Google docs record sheet. It is important that you do this immediately after the experiment because you will inevitably forget and this is a key dependent measure.
Make any notes to further clarify the degree of deception. Also, note anything that was unusual or didn't go well. If the participants made some interesting comments that might provide insights into how they interpreted the task, denote that.